

ORIGINAL ARTICLE

Medicine Science 2021;10(4):1412-6

Evaluation of the relationship of temporomandibular disorders and the morphology of the mandible

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Received 04 Juny 2021; Accepted 19 Juny 2021

Available online 24.11.2021 with doi: 10.5455/medscience.2021.06.199

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Abstract

Temporomandibular joint disorders (TMD) are among the most common problems in the jaw, face, and ear zones. There are multiple factors in the etiology of TMD. It is considered that its morphology may play a role in the etiology of the disease. This study aimed to evaluate the relationship of temporomandibular joint (TMJ) disorder with condyle length, ramus length, condyle width, corpus length, gonial angle, and ramus/corpus ratio. The study was conducted on a total of 100 patients, 50 were symptomatic and 50 were asymptomatic, aged between 16 and 66 years. Symptomatic patients were selected among the patients who presented to our clinic for at least one of the complaints of crepitation, clicking, and pain in the temporomandibular zone on both sides (bilateral). The control group was selected among asymptomatic patients who did not have any complaints in the temporomandibular zone. We evaluated its relationship with TMD by measuring condyle length, condyle width, ramus length, corpus length, gonial angle, and ramus/corpus ratio on CBCT. In the total population, condyle length, ramus length, and condyle width were longer in favor of the control group. However, there was no difference between the ramus/corpus ratio and corpus length. The width of the condyle in female patients with TMD, and the length of the corpus in male patients with TMD were higher in favor of the control group. There is a relationship between TMD and mandible morphology. Knowing the effectiveness of the morphology of the mandible in TME disorders is important in terms of informing individuals with risky morphology beforehand.

Keywords: Temporomandibular joint, temporomandibular disorder, mandibular morphology

Introduction

The temporomandibular joint (TMJ) is between the mandibular fossa of the temporal bone and the processus condylaris of the mandibular bone. As it differs morphologically between individuals, differences can also be seen in the right and left joint areas of the person. TMJ is a diarthrodial joint that contains bone structures, such as mandible and temporal bone, as well as ligament, joint capsule and muscle connections [1].

TMJ is a complex structure that has different features from other joints of the body. Even if both joints show a separate joint function within themselves and move, functional changes in either may affect the other, causing temporomandibular joint disorders (TMD), since these two joints are connected with the mandible [2]. In the etiology of TMD, factors such as malocclusion, trauma,

bruxism, parafunctional habits as well as the pathophysiology of masticatory muscles, age, gender, emotional stress, and psychosocial factors are shown [3].

Morphological features also take an important place among the causes of temporomandibular joint disorders [4]. Genetic characteristics and functional changes occurring in the growth-development period create morphological differences. Since muscle and bone affect each other actively, they can cause significant differences in TMJ morphology [5]. Morphological differences in adults are thought to occur with age and dental status [6]. Loads on joint surfaces affect the morphology of the condyle. One reason for the morphological differences in condyle sizes is thought to be unhealthy occlusion [7]. The gonial angle, ramus dimensions, and dimensions of the mandibular condyle were measured in recent studies conducted to evaluate the morphology of the mandible [8].

In recent years, the use of conical beam computed tomography (KIBT) to evaluate anatomical structures in the oral and maxillofacial zones has increased. The cost advantage of KIBT, low radiation level, and increased image clarity with the

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development of technology has spread its use [9]. The patient is exposed to 15 times less radiation in KIBT compared to computed tomography (CT). Again, KIBT has the opportunity to provide spatial resolution below millimeters with its high diagnostic quality images and provides three-dimensional images from maxillofacial skeletal structures with minimal distortion [10].

Correct diagnosis is important for the effective treatment of TMJ disorders. Therefore, knowing the morphological features of the mandibular bone associated with the joint is important in terms of diagnosis and treatment. This study aimed to evaluate the relationship of TMJ disorder with mandibular morphology by using CBCT.

Materials and Methods

In this retrospective study, the images of the patients who had CBCT images in the Department of Oral, Dental and Maxillofacial Radiology of the Faculty of Dentistry at Inonu University between 2015 and 2020 were evaluated. Ethical approval for this study was obtained from Inonu University Health Sciences Non-Interventional Clinical Research Ethics Committee (2020/1287).

A total of 100 patients, who were aged between 16-66 years and who presented to the Department of Oral, Dental and Maxillofacial Surgery of Faculty of Dentistry at Inonu University were included in the study. Of the patients, 50 were symptomatic and 50 were asymptomatic. Symptomatic patients were selected among the patients who presented to the clinic for at least one of the complaints of crepitation, clicking and pain in the bilateral temporomandibular zone. The patients in the control group were selected randomly among CBCT images of asymptomatic patients who did not have any complaints in the temporomandibular zone. Patients with class 3 malocclusion, patients with any systemic disease that might affect bone metabolism, patients with the syndrome, and patients who had previous surgical operations from the study area were excluded from the study. Records that were found not to have appropriate criteria and did not have sufficient quality for evaluation were excluded from the study.

Cbct Technique

The CBCT images were obtained with the patient in a standard supine position (scanning time, 18 s; field of view, 18×16 cm; exposure time, 3.6 s; kV = 110; mA = 1-20; voxel size, 0.2 mm 3) using a NewTom 5G device (QR Verona, Italy). The head of the patient was placed in a horizontal position so that the Frankfurt horizontal plane was perpendicular to the table, and the head was positioned within the circular gantry housing of the X-ray tube to ensure consistent orientation of the sagittal images. All images were assessed by the NNT software.

Measurements;

All measurements were made on projections of three-dimensional CBCT images onto a two-dimensional plane.

Gonial angle (G°): It was measured as the angle formed by the relative line joining the two posterior borders of the ramus of the mandible and the relative line joining the two inferior borders of the mandible corpus.

Line X: It is the line perpendicular to the relative line connecting the two posterior borders of the mandible from the mandibular notch (MN) and touching mandible.

Condyle length (A-B): The distance between the highest point (A) of the condyle and the X line.

Condyle head width (C-D): It is the widest anteroposterior distance of the condyle head.

Ramus length (E-G): It is the distance of the Gonion point (G) to the X line.

Mandibular corpus length (G-F): It is the distance from the gonion point (G) to the anterior point of the mandible (Figure 1).

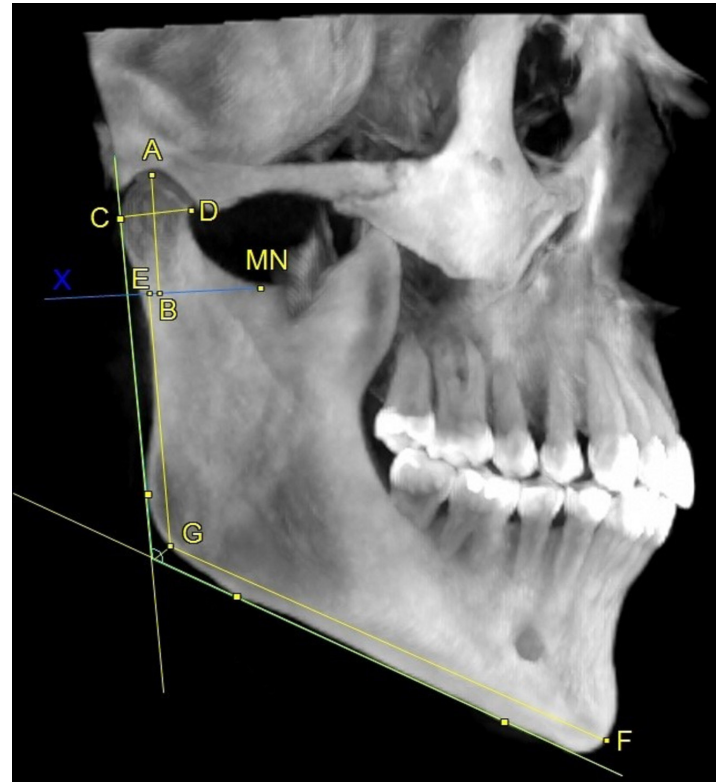


Figure 1. Point, length and gonial angle determined on the CBCT

Statistical Analysis

Data were analyzed with IBM SPSS V23. The suitability of continuous data to normal distribution according to the groups was examined with the Kolmogorov Smirnov test. As the ages were not normally distributed according to the groups, they were compared with the Mann Whitney U test. The distribution of the genders was evaluated with the Chi-square test. Whether the condyle length, ramus length, condyle width, corpus length and gonial angle differed according to the group and gender was examined with two independent samples t-test. The level of significance was taken as $p < 0.05$.

Results

Of 100 patients between the ages 16 and 66, 35 (35%) were men and 65 (65%) were women. 200 morphometric analyzes were performed because the right and left TMJs of the individuals included in the study were evaluated separately. TMD group

consists of 33 women (66%) and 17 men (34%) patients and control group 32 females (64%) and 18 (36%) males.

Median age values do not differ according to the groups. ($p = 0.996$) While the median age in the symptomatic group was 31, it was determined as 31.5 in the control group. The average age of patients with symptoms selected randomly is 33.5 and 66% are women. The average age of the control group is 32.9 and the proportion of women constitutes 64% (Table 1).

Gender distributions according to the groups do not differ ($p=0,767$). While the rate of women in the symptomatic group was 64%, it was 65% in the control group (Table 2).

The mean values of condyle width in women differ ($p= 0.016$). While the mean of the control group was 10.6, the mean of the symptomatic group was 10.0. Average corpus length values in men differs ($p = 0.026$). While the mean of the control group was 76.0, the mean of the symptomatic group was 73.6. Regardless of gender; average condyle values differs ($p= 0.047$). The mean of the control group is 19.0, while the mean of the symptomatic group is 18.1. The average values of ramus length differ regardless of gender ($p=0.042$). While the mean of the control group was 39.3, the mean of the symptomatic group was 37.9. The mean values of condyle width differs regardless of gender ($p=0,048$). The mean of the control group is 10.7, while the mean of the symptomatic group is 10.3 (Table 3).

Table 1. Descriptive statistics table for age

Group	N	Mean	S. Deviation	Median	Minimum	Maximum	P1
TMD	50	33.5	14.1	31.0	16.0	66.0	0.996
Control	50	32.9	12.2	31.5	16.0	62.0	
Total	100	33.2	13.2	31.0	16.0	66.0	

¹Mann Whitney U test

Table 2. Comparison of gender according to the groups

	TMD	Control	Total	P1
Gender				
Female	33 (66)	32 (64)	65 (65)	0.767
Male	17 (34)	18 (36)	35 (35)	

¹Pearson Chi-square test, n (%)

Table 3. Comparison of gender according to the groups

	Gender	Control Group		Symptomatic group		P1
		Avg. ± S. Deviation	Avg. (min. - max.)	Avg. ± S. Deviation	Avg. (min. - max.)	
Female	Condyle length	18.6 ± 2.6	19.1 (11.5 - 25.3)	17.6 ± 3.6	17.6 (7.7 - 27.9)	0.085
	Ramus length	37.5 ± 3.1	37.1 (30.8 - 45.1)	36.5 ± 4.1	36.0 (26.1 - 44.4)	0.116
	Condyle width	10.6 ± 1.4	10.5 (7.8 - 13.7)	10.0 ± 1.4	10.0 (7.2 - 13.9)	0.016
	Corpus length	71.1 ± 5.0	70.4 (60.9 - 84.2)	71.2 ± 5.2	71.5 (55.4 - 81.1)	0.892
	Gonial angle	124.2 ± 8.3	124.6 (107.7 - 140.4)	126.8 ± 9.0	126.4 (107.5 - 149.1)	0.084
	Ramus/Corpus ratio	0.5 ± 0.1	0.5 (0.4 - 0.6)	0.5 ± 0.1	0.5 (0.4 - 0.7)	0.151
Male	Condyle length	19.8 ± 3.1	19.9 (12.5 - 26.8)	19.2 ± 2.7	19.1 (14.0 - 27.3)	0.34
	Ramus length	42.4 ± 4.0	42.7 (33.6 - 50.3)	40.7 ± 5.6	40.8 (31.2 - 53.2)	0.150
	Condyle width	11.1 ± 1.4	11.3 (7.7 - 13.7)	11.0 ± 1.8	11.1 (7.6 - 16.3)	0.853
	Corpus length	76.0 ± 4.6	76.2 (63.8 - 84.8)	73.6 ± 4.4	72.8 (66.4 - 81.2)	0.026
	Gonial angle	122.9 ± 7.9	122.3 (107.1 - 140.4)	123.1 ± 9.1	123.8 (103.2 - 144.0)	0.911
	Ramus/corpus ratio	0.6 ± 0.1	0.6 (0.4 - 0.7)	0.6 ± 0.1	0.6 (0.4 - 0.8)	0.774
Total	Condyle length	19.0 ± 2.9	19.2 (11.5 - 26.8)	18.1 ± 3.4	18.3 (7.7 - 27.9)	0.047
	Ramus length	39.3 ± 4.2	38.6 (30.8 - 50.3)	37.9 ± 5.1	37.4 (26.1 - 53.2)	0.042
	Condyle width	10.7 ± 1.4	10.8 (7.7 - 13.7)	10.3 ± 1.6	10.5 (7.2 - 16.3)	0.048
	Corpus length	72.9 ± 5.4	72.8 (60.9 - 84.8)	72.0 ± 5.0	72.3 (55.4 - 81.2)	0.25
	Gonial angle	123.7 ± 8.2	123.8 (107.1 - 140.4)	125.5 ± 9.2	125.9 (103.2 - 149.1)	0.132
	Ramus/corpus ratio	0.5 ± 0.1	0.5 (0.4 - 0.7)	0.5 ± 0.1	0.5 (0.4 - 0.8)	0.195

¹Two independent sample t tests

Discussion

There are many reasons for the etiology of TMD, such as degenerative and inflammatory joint diseases, parafunctional habits, malocclusion, trauma, and condyle-disc disorders [11]. It has been shown in the studies that morphological features are among the causes of temporomandibular joint disorders [12]. We investigated the effectiveness of morphology in our study.

It was reported that gender plays a role in TMJ diseases more than dental factors [13]. In a study conducted on TMJ diseases, it was shown women are more likely to develop TMJ diseases compared to men [14]. In parallel with these data, the ratio of women in the symptomatic group was 66% and this result is consistent with the results of previous studies. The use of oral contraceptives and the stimulation of estrogen receptors to the joint ligaments are considered as a result of this in women [15].

In this study, the average age of the individuals in the symptomatic group is 33.2. The studies on the epidemiology of temporomandibular joint disorder showed that the symptoms of the disease were most common in the 20-40s, in accordance with our study [16]. In a study conducted on a large population of TMJ patients, it was reported that TMJ diseases were observed more in younger individuals than in the elderly [17].

Using different imaging techniques, normal functions and pathologies of TMJ can be evaluated. It is difficult to visualize the joint entirely on conventional radiographs due to the superposition of the adjacent anatomical structures [18]. For this reason, 3D imaging techniques are superior to conventional radiographs in the imaging of hard tissues. Also, computed tomography provides superior results compared to lateral transcranial views in demonstrating the correct condylar position and anatomical changes in the bone structure. Computed CBCT, which allows imaging without superposition of adjacent structures and provides thin image sections, is a frequently used method in the examination of TMJ [19, 20].

In a study conducted on linear measurements obtained with digital caliper and CBCT on mandibles obtained from cadavers, 95% compatibility was found between the two methods [21]. There was another study that compares linear measurements obtained with digital caliper and CBCT on 15 skull heads and it was concluded that there was no significant difference between the two techniques [22]. We used CBCT in this study due to its advantages in providing three-dimensional imaging of maxillofacial skeletal structures.

There are studies showing that the height of the condyle in the joints is shorter in patients with TMJ osteoarthritis compared to healthy individuals [23]. Similarly, in our study, the condyle height of the symptomatic group was significantly shorter than the control group, regardless of gender. Moreover, the condyle width, which is another data of our study, is significantly shorter relatively the control group. The findings related to condylar morphology in our study, support the study hypotheses that low-volume condyles are associated with the presence of TMD symptoms [23].

In a study that compared symptomatic TMD patients with asymptomatic individuals, a significantly reduced ramus height was found on MRI scans of symptomatic patients [24]. In another

study, it was observed that the height of the ramus was decreased in patients with osteoarthritis [25]. Likewise, in our study, the ramus height of the symptomatic group is shorter than the control group, regardless of gender.

According to the literature, there is a relationship between the hyperdivergent jaw growth pattern and TMDs [26]. In the light of this information, it can be stated that there is a significant relationship between lower facial structure and TMD in individuals with hyperdivergent facial type [27]. In a study that compared symptomatic TMD patients with asymptomatic individuals, a significantly increased gonial angle was noted on MRI scans of symptomatic patients [24]. There are some studies in literature showing that the height of the ramus was decreased and the gonial angle was increased in patients with osteoarthritis [23, 25]. In line with this information, this study showed that there is no difference between the gonial angles of the symptomatic group and the control group and the average of the gonial angles in the symptomatic group was greater. In the literature review, we could not find any study evaluating the etiological relationship between TMD and ramus/corpus ratio. In this study, we could not find any difference between the symptomatic group and the control group in terms of ramus/corpus ratio.

In literature, studies are showing that the corpus length of individuals with TMD is shorter than the healthy group [28]. Another study demonstrated that the corpus length of the individuals with TMD is shorter than healthy individuals [29]. In this study, the corpus length of the symptomatic group is not different from the control group, regardless of gender. However, in terms of the average values, the corpus length of the symptomatic group is shorter. Moreover, the corpus length is slightly shorter in symptomatic men compared to asymptomatic men.

Conclusion

This study showed that there is a relationship between TMJ and mandible morphology. Knowing the effectiveness of the morphology of the mandible in TMJ disorders is important in terms of informing individuals with risky morphology beforehand. We think that the results of our study will also contribute to artificial intelligence studies on TMJ diseases.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

Approval of the Local Research Ethics Committee of our tertiary hospital was obtained before initiating the study (project no: İ10-622-10, date:14.01.2021)).

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